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CONTENTS

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INTERNATIONAL COOPERATION TO IMPROVE RICE PRODUCTION AND PROCESSING

by

Ralph W. Phillips[1]

ANY account of international cooperation to improve rice production and processing must necessarily be, to a considerable extent, an account of the activities carried out in connection with the FAO International Rice Commission (IRC). That Commission, which formally came into existence on 4 January 1949, has provided a focal point for consideration of common problems by countries and for the implementation of a number of cooperative studies and projects. This paper is, therefore, limited to a brief account of the activities carried out by, or upon the recommendation of the Commission, and to an indication of the manner in which future activities might be organised.

Activities during 1949-1954

A paper dealing with "The Work of International Rice Commission - Past and Future" appeared in the September 1954 issue of the IRC News Letter (Phillips, 1954), in which a rather complete summary of the activities up to the Fourth Session of the IRC was given. It will be recalled that, while the IRC and certain working parties associated with it had dealt with many subjects, intensive consideration had been given only to rice breeding and fertilizers.

Briefly, the history of these two major activities was as follows:

1. The establishment of a working party on rice breeding was recommended by the First Session of the IRC in Bangkok in 1949. The delegates, not being certain of the manner in which such a working party would act or what it could achieve, did not agree to a proposal for a separate meeting some months before the Second Session in order to initiate work in this field. Therefore, the *Working Party on Rice Breeding* held its first meeting in Rangoon in 1950, just before the Second Session of the IRC.

In the first meeting, the Working Party decided upon the major problems to which it should give attention, proposed the holding of training centers, recommended the appointment by FAO of a full-time expert on rice breeding (the expert entered on duty in January 1952), and laid the basis for a rice hybridization project utilising *Indica* and *Japonica* stocks. These and other achievements of that first meeting gave the participants and the delegates to the Second Session of IRC a good indication of the usefulness of what may be called the "working-party technique." Therefore, there was strong support for the continuation of the Working Party and it was

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convened by FAO for its second, third, fourth and fifth meetings in 1951, 1952, 1953 and 1954 in Bogor, Bandung, Bangkok and Tokyo respectively.

The meetings mentioned above provided excellent opportunities for the exchange of information on many aspects of rice breeding, for joint consideration of some topics with the Working Party on Fertilizers, for the participants to study at first hand the work under way in Indonesia, Thailand and Japan, and to forward the work on hybridization of *Indica* and *Japonica* stocks. In addition, a regional training center on rice breeding was held by FAO in Cuttack, India, in 1952, following the recommendation of the Working Party, with twenty-three trainees from ten countries in attendance.

2. The possibility of forming a working party to deal with fertilizer problems was discussed in the First Session of the IRC in Bangkok in 1949, but the action taken was limited to a recommendation for the collection of information which might serve as a basis for setting up a working party to develop a coordinated program in relation to fertilizer experimentation and practice. After considering various problems of rice fertilization, and having seen the results of the first meeting of the Working Party on Rice Breeding, the Second Session of the IRC recommended the establishment of a working party on fertilizers.

FAO organized the first meeting of the *Working Party on Fertilizers* in Bogor in 1951. This was followed by meetings in 1952, 1953 and 1954 in Bandung, Bangkok and Tokyo, a portion of each meeting being held jointly with the Working Party on Rice Breeding. Specialists from various countries were given an opportunity in these meetings to exchange information on all important aspects of fertilizer and manure experimentation and use, and on the solution of soil fertility problems pertaining to rice culture, and to see the work under way in the countries where meetings were held. Particular attention was given, during 1953 and 1954, to experimental designs for response curves. This work has provided the basis for extensive studies in various countries aimed at determining the fertilizer policies and practices governments should advocate. Also, following a recommendation of the Working Party, FAO held a regional training center on soil fertility in Coimbatore, India, in 1952, at which there were nineteen trainees from seven countries.

Other topics which received the attention of the IRC during the 1949-54 period included many items which may be grouped under the headings:

(a) mechanization of rice production
(b) other rice production problems
(c) development of extention services in relation to rice production
(d) reducing losses through improved operational practices
(e) utilization of rice by-products
(f) nutritional aspects of rice
(g) economic and related aspects of the rice industry
(h) use of rice fields for fish culture.

Lists of the topics and sub-topics discussed may be found in the paper by Phillips (1954) and in the reports of the various sessions and meetings listed under

"References" at the end of this paper. The amount of attention given to the different topics varied widely, but in no case did a topic receive consideration comparable to that which was possible for topics dealt with by the two working parties, where competent specialists in the fields of rice breeding and fertilizers participated.

Activities during 1955-1956

The Fourth Session of the IRC, held in Tokyo in October 1954, recommended that detailed attention be given to five fields of work, thus setting the pattern for developments in 1955 and 1956. The main activities were:

1. Rice Breeding. The Working Party on Rice Breeding continued to function along the same lines as in earlier years. However, since the work was well established and there was need for FAO to begin work in other fields, it was decided that, after the fifth meeting held in Penang in 1955, meetings would be organized on a biennial basis; hence no meeting was held in 1956, but contacts were maintained by correspondence. During this period the rice hybridization project was brought to a close and arrangements were made for the further testing of promising lines in various countries. The work of the regional expert on rice breeding continued. A second regional training center on rice breeding was also held by FAO in Cuttack, India, in 1955, with twenty trainees from thirteen countries participating.

2. Fertilizers. The Working Party on Fertilizers also continued to function along the same lines as in earlier years. Following a recommendation of the Working Party, FAO appointed a regional expert on fertilizers, who took up his duties in November 1955, particularly to assist the countries of Asia and the Far East in their rice fertilizer experimentation and in the planning of fertilizer-use programs. Following the recommendation of the Working Party, a second regional training center on soil fertility was held by FAO in 1955 at Hyderabad, India, at which thirty-two trainees from twelve countries were in attendance.

3. Problems of Soil-Water-Plant Relationships. The intricate and important problem of soil-water-plant relationships in rice production was first discussed by the IRC at its Third Session in Bandung in 1952. Subsequently, it was considered in joint meetings of the Working Parties on Rice Breeding and on Fertilizers in 1953 and 1954. As a result of these preliminary discussions, the IRC at its Fourth Session in Tokyo, recommended that FAO establish an *ad hoc* Working Group on Problems of Soil-Water-Plant Relationships composed of representatives of from five to seven countries, which would study the problem and recommend further action to the Fifth Session of the Commission. The findings of the Working Group are summarized in the report of the Fifth Session of the Commission.

4. Problems of Mechanization of Rice Production under Wet Paddy Conditions. At its first three sessions in 1949, 1950 and 1952, the IRC had given limited attention to problems of mechanization of rice culture, including devices for lifting water for irrigation, hand and animal-powered equipment and machinery, and motorized equipment for tilling and harvesting. At its Fourth Session,

the IRC recommended that FAO should set up an *ad hoc* Working Group on Problems of Mechanization of Rice Production, composed of representatives of from five to seven countries, and that it should prepare a report on both the technical and farm management aspects of the problem as a basis for consideration of further action by the Fifth Session.

The Working Group met in Peradeniya, Ceylon, in May 1956 to finalize its report, which includes a comprehensive analysis of the problems. Although the Working Group was able to bring together a great deal of useful information which has been made available in its report, it found many gaps in existing information and made a number of recommendations both to governments and to FAO for further activities in this field.

Following the Fourth Session of the Commission, an approach was made to a privately-financed foundation, the Council on Economic and Cultural Affairs, for assistance in this work, and that Council approved a grant to FAO for the employment of a specialist to assist in the development of this work. One specialist served for a year during the 1955-56 period, and made an intensive study of the farm management aspects of the problem through visits to the countries of Asia and the Far East and in connection with the activities of the *ad hoc* Working Group on Problems of Mechanization of Rice Production.

A farm management development center for Asia and the Far East was held in Tokyo in 1956 as a first step in training additional workers to undertake studies in this important field.

5. **Storage and Processing.** At its first three sessions in 1949, 1950 and 1952, the IRC gave some attention to the reduction of losses in rice through improved operational methods, including (a) harvesting, drying, storing and handling, (b) conventional milling operations, and (c) parboiling. However, it was not until its Fourth Session in Tokyo that the IRC decided to recommend some definite steps in this field. As a first approach to the problem, it was proposed that FAO should establish an *ad hoc* Working Group on the Storage and Processing of Rice to look carefully into the various aspects of the problem, thus providing a basis for discussion at the Fifth Session of the IRC and also a basis for determining future action in this field. Much material was brought together as a result of correspondence with members of the Working Group during 1955 and 1956, and a meeting of the Working Group was held in Calcutta prior to the Fifth Session of the IRC. This provided the first real opportunity for inter-country consultation by experts who are dealing with one of the most important problems of making adequate supplies of rice available in satisfactory condition to the consumers. The evidence accumulated during the preliminary work and in the meeting in Calcutta indicated clearly the possibilities of reducing losses by a very substantial degree and increasing the amount and quality of rice available from existing production.

6. **Other Technical Problems.** Other problems which received attention during the Fifth Session of the IRC were (a) recent developments on nutritional problems related to rice; (b) recent developments on the use of rice fields for fish culture; and (c) the place of crop rotations in rice culture. Discussions of the first two subjects were aimed primarily at giving the delegates an opportunity to exchange information on new developments in their respective countries, while the discussion of the third subject revolved around the question of whether the place of crop rotations in rice culture should have a major place on the agenda of future sessions. Attention was also given to the question of whether or not the IRC should recommend further work on protection of rice in the field.

7. **IRC News Letter.** FAO continued to issue the News Letter during 1955 and 1956, and at the end of 1956 a total of twenty numbers had been published. This News Letter was proposed at the first session of the IRC in 1949. However, owing to the failure of countries to submit sufficient material, the first issue was not published until February 1952. The News Letter has served a very useful purpose and many papers of excellent technical quality have appeared in it. However, owing to financial limitations, it has had to be issued on a very informal basis, and the material published in it has not had the wide circulation and attention that it deserves.

Action of the Fifth Session of the Commission

The IRC, having considered reports of the two working parties and three *ad hoc* working groups, and having discussed other problems, recommended that:

(a) The work which had been developed under the Working Party on Rice Breeding should be continued, taking into account the need for greater attention to the development of basic research relating to the rice plant;

(b) The activities initiated by the Working Party on Fertilizers should be continued, particularly in view of the need for effective means of facilitating exchange of information and developing cooperation among countries;

(c) The *ad hoc* Working Group on Soil-Water-Plant Relationships should be reconstituted in suitable form for another two-year period with a somewhat enlarged membership;

(d) Five to seven member countries of the IRC in Asia and the Far East region and two or three member countries from outside this region should be invited to form an advisory group on the technical aspects of mechanization, the exact form of the group to be determined by FAO. It was also recommended that FAO should continue its work

designed to assist governments in the establishment and development of national projects in the farm management field, with particular reference to rice, provided funds were available;

(e) The activities initiated by the *ad hoc* Working Group on Storage and Processing of Rice should be continued and should constitute one of the major activities of the IRC; and

(f) Steps should be taken to develop inter-country cooperation with regard to the reduction of losses of rice in the field, such activities being fully coodinated with other activities related to rice production.

The IRC also made certain proposals regarding further attention to the use of rice fields for fish culture, but this did not involve any special organizational arrangements under the aegis of the IRC.

The IRC, of course, made recommendations on a number of technical subjects, but in the above listing attention is given only to those related to the organizational arrangements necessary to carry out the technical work.

In its consideration of organizational arrangements, the IRC made a tentative proposal that, in future, the technical activities related to the IRC might be organized in two main groups dealing with:

(a) Rice production, including rice breeding, fertilizers, soil-water-plant relationships, protection of rice in the field, and related subjects such as agronomic and cultural practices, and crop rotations in rice production; and

(b) Conservation, including the entomological and engineering aspects of rice storage, the engineering and technological aspects of rice processing, and the effects of these conservation measures on nutritive value of the rice.

In making this rccommendation, the IRC expressed its appreciation for the good work done by the existing Working Parties and *ad hoc* Working Groups, and commended to FAO the continued use of similar methods of work in furthering the activities of the IRC. The IRC also stressed the need for giving due attention to close collaboration among scientists within the limited subject-matter fields, while at the same time ensuring close collaboration between groups dealing with the different fields. In addition, there was recognition of the necessity for limiting the total number of international meetings to those which were essential to the conduct of the technical work.

From the foregoing, it will be seen that the IRC was concerned about the desirability of consolidation of efforts, while at the same time safeguarding what, earlier in this paper, has been called the "working-party technique" which had been so productive in the activities of the IRC up to the time of the Calcutta session, as well as in other phases of FAO's work.

Table 1. Participation by Member Countries in Sessions of the International Rice Commission and Meetings of Working Parties and *ad hoc* Working Groups

Session or Meeting	Year	Australia	Burma	Cambodia	Ceylon	Cuba	Dominican Republic	Ecuador	Egypt	France	India	Indonesia	Iran	Italy	Japan	Korea	Laos	Mexico	Netherlands	Pakistan	Paraguay	Philippine Republic	Portugal	Thailand	United Kingdom	U.S.A.	Viet Nam	Number: Members	Number: Participants
International Rice Commission	1949	(x)	x	o	x		o			x	x	o	o	x	(x)*	o	o		x			x	o	x	x	x	o	16	13
	1950	(x)	x	o	x		o		x	x	x	x	o	x	(x)*	o	o		x			x	(x)	x	x	x	o	17	15
	1952	(x)	x	x	x					x	x	x	o	x	x	o	(x)		x	x		x	o	x	x	x	x	21	17
	1954	x	x	x	x	x			x	x	x	x	x	x	x	x	x		x	x		x	o	x	x	x	x	25	21
	1956	x	x		x		x			x	x	x		x	x		x		x	x		(x)		x		x	x	26	15
Rice Breeding	1950	o	x	o	x		o			x	x	x	o		(x)*	o	o		x	x			o	x	x	x	o	17	9
	1951	o	x	o	x		o			x	x	x	o	x	(x)*	o	o		x	x		x	o	x	x	x	x	18	14
	1952	o	x	x	x					x	x	x	o		x	o	o		x	x			o	x	x	x	x	21	13
	1953	x	x	x						x	x	x	o	x	x	(x)	(x)		x	x		x	o	x	x	x	x	21	17
	1954	x	x		x						x	x			x	x			x	x			o	x	x	x	x	25	14
	1955	x	x						x	x	x	x			x	x	x		x	x		x		x	x	x	x	26	15
Fertilizers	1951	o	x	o	x		o			x	x	x	o	x	(x)*	o	o		x	x		x	o	x	x	x	x	18	14
	1952	o	x		x					x	x	x	o		x	o	o		x	x			o	x	x	x	x	21	12
	1953	x	x	x						x	x	x	o	x	x	(x)	(x)		x	x		x	o	x	x	x	x	21	17
	1954	x	x		x	x			x	x	x	x			x	x	x						o	x	x	x	x	25	15
	1955		x		x					x	x	x			x	x								x	x	x	x	26	12
Storage and Processing	1956	—	x	—	x	—	—	—		x	x	x			x		—		x	x	—			x		x	x	19	11
Mechanization	1956	—	x	—	x	—	—	—	—	—	x	—	—	—	x	—	—	—		—	—	—	—		x	—	—		5

o = country not yet member of International Rice Commission.

x = delegate; (x) = observer; — = government not participating this activity.

* = Japan was represented by observers in these years through the Supreme Command of the Allied Powers.

Activities in 1957 and Proposals for Work in Later Years

When considering the future work of the IRC, it seems desirable to examine the extent to which members of the IRC have participated in the various activities and also the extent to which the methods of carrying out work in the past have been effective.

Participation of Countries in Various Activities

A summary is presented in Table 1 showing the extent to which each country has participated in each of the major activities of the IRC. The first section of the table deals with the participation in the sessions of the IRC itself. The second and third sections deal with participation in the meetings of the Working Party on Rice Breeding and the Working Party on Fertilizers. The last two sections deal with the meetings of the *ad hoc* Working Groups on Storage and Processing and on Mechanization of Rice Culture each of which met once during 1956. In the case of the *ad hoc* Working Group on Storage and Processing, only nineteen of the twenty-six member countries of the Commission indicated their desire to participate in this activity, while in the case of the *ad hoc* Working Group on the Mechanization of Rice Culture, it was agreed that participation should be limited, so only seven of the twenty-six member governments were actually participating.

Although the IRC is international in scope, it has tended to become regional in nature, probably because of the fact that the sessions and meetings have, prior to 1957, all been held in Asia and the Far East, thus making it difficult for member countries of the IRC, particularly those in Latin America, to send participants. This may be seen from an examination of Table 1. This raises a question as to whether or not the IRC organizational arrangements should continue essentially in their present form or whether they should be altered so that problems in the Asian and the Far East, Near East and Mediterranean areas might be handled in one segment of the Commission, leaving other areas, and particularly Latin America, to be served by other means. The main object here is to call attention to the problem.

The "Working-Party Technique"

Most workers who have participated in the IRC sessions and who have had an opportunity to watch the activities of the Working Parties and *ad hoc* Working Groups will, no doubt, agree that the success of the IRC has depended very largely on the excellent performance of these Working Parties and Working Groups. They have provided opportunities for the leading specialists of the member countries to come together to exchange information, to plan their research so that activities in one country might supplement those in other countries and duplication be avoided thereby, and to plan cooperative projects such as the rice hybridization project. Also, there can be little doubt that the stimulation provided by the contacts in these meetings has resulted in more effective work in many countries. During the years that the IRC has been in existence the trend has been steadily toward a situation in which it has become an "umbrella" under which the activities of the Working Parties and Working Groups were carried out. The sessions of the IRC have

been devoted to a considerable extent, particularly in recent years, to reviews of the activities of these Working Parties and Working Groups. In addition, the sessions have provided opportunities for policy-making officials to come together to consider common problems and to see the work under way in various countries in Asia and the Far East. A matter of primary concern, in considering any possible reorganization of the work, is that of safeguarding the effective use of what is referred to here as the "working-party technique", since this does seem to be the most effective mechanism thus far developed in dealing with technical problems of interest to a group of countries.

Meetings of the Working Parties on Rice Breeding and on Fertilizers and of the *ad hoc* Working Group on Soil-Water-Plant Relationships in 1957

It will be recalled that a decision was taken at the end of 1955 to discontinue annual meetings of the Working Parties on Rice Breeding and on Fertilizers, and to hold them on a biennial basis. Thus, no meetings were held in 1956. The *ad hoc* Working Group on Soil-Water-Plant Relationships, which was reconstituted by FAO for a further period ending with the Sixth Session of the IRC, had not held any meeting prior to 1957. Therefore, regardless of the final organizational structure for the work carried out under the auspices of the IRC, FAO decided to convene a combined meeting of the two Working Parties and of the *ad hoc* Working Group on Soil-Water-Plant Relationships in September 1957 in Vercelli, Italy. In the past, the two Working Parties had held meetings concurrently and had discussed certain items on their respective agenda on a joint basis. Having in mind the desirability of maintaining close contact between the Working Parties and the *ad hoc* Working Group, it was decided to hold a combined meeting in 1957 with many of the agenda items being treated in plenary sessions, while certain items would be handled in subsidiary meetings where specialists on rice breeding, fertilizers and soil-water-plant relationships could deal with the more specialized aspects.

Activities of the *ad hoc* Working Group on Mechanization of Rice Culture and the *ad hoc* Working Group on the Storage and Processing of Rice

It will be recalled that the Fifth Session of the IRC recommended that work be continued in the two fields covered by these *ad hoc* Working Groups. Pending the time when the overall arrangements for IRC activities could be decided, arrangements were made by FAO for the reconstitution of these two *ad hoc* Working Groups, on the understanding that they would continue to exist until the Sixth Session of the IRC was held. No meetings were scheduled during 1957, however, and contacts were maintained with the members of the *ad hoc* Working Groups by correspondence, and by FAO staff visits to a number of countries. A second specialist in farm management, appointed by FAO under a grant from the Council on Economic and Cultural Affairs, began his work in May 1957.

Activities related to Reduction of Losses of Rice in the Field

Following the recommendation of the Fifth Session of the IRC on this subject, steps have been taken during 1957 to study the possibilities of developing inter-country cooperation, particularly by arranging for a staff member to visit many of the member countries of the IRC, in order to become fully acquainted with the problems and the possible avenues of inter-country action.

Possible Lines for Future Development

Reference has already been made to the discussion in the Fifth Session of the IRC regarding the possibilities of consolidating the work on various subjects being carried out under the auspices of the IRC, while at the same time safeguarding the technical quality of the work by ensuring that each field is dealt with by specialists in that field. In addition to these considerations, it must be recognized that governments have budgetary problems which relate both to the sending of representatives to meetings and the expenses incurred when governments act as hosts to meetings. It would be desirable to find organizational arrangements which would ensure the continuity of the work at a high technical level and at the same time would keep expenses at a minimum not only for governments but also for FAO, which has its budget problems too. Therefore, the work carried out by FAO and its member countries which are members of the IRC might be organized in the manner outlined below.

The IRC sessions might, in future, provide opportunities for meetings of specialized groups and at the same time might provide opportunities for exchange of information among these groups and for the coordination of the various activities for the improvement of rice production and processing. In order to keep the numbers of technical groups as small as possible, yet give reasonably adequate technical coverage in logical subject matter groups, the following might be established in place of the existing groups or to cover subjects for which no groups now exist:

1. Sub-Commission on Rice Improvement

This sub-commission might promote international collaboration in all problems related to the improvement of rice such as the exchange of seed, selection and hybridization; the certification, production and distribution of seed; the biology, genetics and cytology of the crop; agronomic problems such as the methods of cultivation and the diversification of cropping systems incorporating fertility-maintaining rotations.

2. Sub-Commission on Rice Soils and Fertilizer Practices

This sub-commission might promote international collaboration relating to rice soils, the use of fertilizers and manures on rice soils and the problems of soil-water-plant relationships. Any aspects of these problems having a bearing on the agronomic aspects of rice production could be considered jointly with the Sub-Commission on Rice Improvement, whenever such joint consideration was required.

3. Sub-Commission on Rice Protection

This sub-commission might promote international collaboration in the study of the biology of pests, rodents and diseases in

the growing rice crop, and their prevention and control by cultural or chemical or biological methods; the biology and control of pests, rodents and diseases in the harvested crop, paddy and milled rice in storage and transit; other aspects of the storage of the harvested crop, paddy and milled rice, with the exception of those related to engineering.

4. Sub-Commission on Engineering Aspects of Rice Production, Storage and Processing

This sub-commission might take over the activities of the *ad hoc* Working Group on the Storage and Processing of Rice which are related to the construction of storage facilities and to the engineering aspects of processing and also to functions of the *ad hoc* Working Group on the Mechanization of Rice Culture. Thus, it might deal with mechanization of rice culture, engineering aspects of rice storage, rice processing (including drying, testing, parboiling and packing) and the mechanical aspects of grading. Although the farm management aspects presently handled by the *ad hoc* Working Group would be carried on outside the framework of the IRC, this sub-commission might report to the Commission on progress made in farm management as related to rice production. This would enable the IRC to keep under current review the activities and advances made in the field of farm management and production economics as it relates to raising the efficiency of rice production and the incomes of rice producers.

Thus, each session of the IRC might consist of plenary meetings at the beginning and at the end, with sub-commission meetings in between wherein specialists in each of the above fields might meet to give careful attention to the technical problems falling within each sub-commission's terms of reference. The meetings might be so arranged that during a period of approximately two weeks, one working day at the beginning and one at the end might be devoted to plenary sessions, while two of the sub-commissions might meet simultaneously for four days and the other two for the succeeding four days, but with suitable arrangements for joint sessions of certain sub-commisions, where required, and with breaks for field trips and finalization of reports. The report of each sub-commission could be so prepared that it would form an integral part of that particular session of the IRC.

In order to facilitate preparations for sessions and to ensure as much continuity as possible in the membership of the sub-commissions, governments might be requested to designate correspondents for each of the sub-commission. In some cases, governments might be asked to name two or more correspondents for a particular sub-commission, thus giving coverage to the various aspects of the work of a sub-commission, such as for example, in connection with the fourth sub-commission mentioned above, correspondents might be designated to deal with mechanization of rice in the field, with the construction of storage facilities and with the mechanical aspects of processing. In some countries one man might cover all fields, while in others, either two or three correspondents might be designated for this particular sub-commission, depending upon the availability of personnel. Governments might not necessarily be expected to designate correspondents for every com-

mission, but only for those where they had sufficient specialized manpower to give definite contributions.

In addition to the four sub-commissions mentioned, there might be a further sub-commission, namely:

5. Sub-commission on Rice Production and Processing Problems in Latin Amarica

Such a sub-commission would provide an opportunity for discussion of all aspects of rice production and processing in Latin-Amarican countries and sessions might be held in the years between full sessions of the Commission, thus giving the Latin-American countries an opportunity to benefit from the findings of the previous session of the Commission itself.

Assuming that the above arrangements are adopted, it would take some years to bring them fully into effect. The sequence of events might be roughly as follows:

(a) in *1957* there has been, as a first step, a combined meeting of the Working Party on Rice Breeding, the Working Party on Fertilizers and the *ad hoc* Working Group on Soil-Water-Plant Relationships. A single report is to be issued covering this combined meeting;

(b) the IRC would meet in *1958*, in accordance with the constitutional provision that a session be held every two years. The 1958 session would include sectional meetings of the existing *ad hoc* Working Group on Storage and Processing, the *ad hoc* Working Group on Mechanization of Rice Culture and a section dealing with the protection of rice in the field. Reports of all these technical discussions would be embodied in the overall reports of the sixth session of the Commission. This session of the Commission would provide some experience in the proposed arrangements, and also an opportunity for full discussion of proposed future arrangements which might lead to the establishment of the proposed structure in 1960;

(c) in *1960* there might be a full session of the IRC and the first four sub-commissions proposed above, assuming the pattern suggested is adopted. In the meantime, following the Sixth Session of the IRC, the present working parties and *ad hoc* working groups would have been dissolved and the four new sub-commissions formally established, including the designation of correspondents by governments;

(d) the fifth sub-commission, dealing with rice production problems in Latin-America, might meet first in *1961*, thus giving ample opportunity to include provision for it in the Program of Work and Budget and at the same time, enabling it to profit from the findings of the Seventh Session of the IRC itself which would have been the first full meeting involving all technical aspects covered by the first four sub-commissions listed above.

The arrangement outlined above, adopted, and if it is to be most effective, would require that each member country send a sizeable delegation to each session of the IRC. Naturally, many countries would

not be in a position to send specialists in all fields to each session, either because, in some cases, they will not have specialists in all subjects mentioned above, or because of the costs involved. However, if a definite plan were known well in advance, each country could make budgetary provisions for participation of specialists in all those fields in which it had work under way or in which it had substantial interests. The costs to governments over a period of years should be lower than if the present arrangements were continued.

The burden placed on a host government would be greater than for previous sessions of the IRC or meetings of working parties, but if a reasonable system of rotation were followed, intervals between years in which any one country would be called upon to serve as host would be long, thus also reducing the average cost to each government over a period of years.

General Observations and Conclusion

The proposals outlined above constitute only one of many organizational plans that might be adopted. The term "sub-commission" has been used for the technical groups since this is in line with the basic idea that the primary groups under a commission should be called sub-commissions while secondary groups might be called working parties or working groups.

One alternate approach which would conform more exactly to the proposal made at the Fifth Session in Calcutta might provide for the establishment of two sub-commissions dealing respectively with rice production and rice conservation. Under these sub-commissions, various existing working parties might be continued or new ones set up. However, it should be recognized that such an arrangement would be more cumbersome because the findings of the technical groups would have to pass thru intermediate bodies before coming before the IRC itself. Also, advantage could not be taken of certain subject-matter combinations proposed above, i.e. bringing the biological aspects of rice protection in the field and after harvesting together in one sub-commission, and the mechanical aspects of rice production, storage and processing in another.

In conclusion, it should be emphasized that the proposals set forth above are presented, together with background information on the development of activities associated with the International Rice Commission, primarily to provide a basis for full consideration within countries well before the Sixth Session of the Commission. FAO will, no doubt, be placing more concrete suggestions before the Sixth Session; these will form the official basis for discussion. In the meantime, it is hoped that officials of all members countries of the IRC, who are concerned with the work of the Commission, will find the contents of this paper useful in developing their own ideas concerning the manner in which the Commission's work might be carried out most effectively in the future.

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IRRIGATION FACILITIES FOR RICE CULTURE IN TAIWAN

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Irrigation facilities in Taiwan are mainly for rice culture. This is because the profit from rice growing is higher in comparison with all other crops.

Historically, irrigation work in Taiwan can be traced as far back as the Yuan Dynasty (1279-1368) of China. At that time, Taiwan was already a part of China. The land was reclaimed by the immigrants from mainland China with the so-called net-canal irrigation and drainage system. Later in the Ming Dynasty (1368-1662), General Cheng Chen-kung came to Taiwan, with waves of people following him from the mainland. They further developed the irrigation system, in order to produce more food for the people and the soldiers. By 1683, when the Ching Dynasty (1644-1911) had sovereignty over Taiwan, irrigation systems were developed to a still greater extent. This continued for a

period of 212 years until 1895 when the Japanese took control of Taiwan. Up to that time, there ware 351,019 hectares of cultivated land, of which 196,679 were irrigated. All canals, except one, were built and maintained by individual farmers or by a group of farmers, practically with no assistance from the Government.

After Taiwan was occupied by Japan in 1895, there had been remarkable development in irrigation work in an effort to develop Taiwan into a main rice and sugar production area. An enormous amount of investment had been made by the Japanese on irrigation in Taiwan. Some of the highlights were (a) improvement of the original irrigation systems by introducing more scientific methods; (b) research and experimentation on water duty and establishment of gauging stations; (c) overall reconnaissance of all irrigation systems for possible development and extension; (d) supervision and administration for all systems; (e) help in financing irrigation projects; and (f) construction of several large irrigation projects, notably, the Chia-nan Canal System. By the time of the restoration of the Island to China in 1945, there were about 523, 208 hectares of irrigated land out of a total of 816,016 hectares of cultivated land. However, the actual area planted to paddy rice was only 499,531 crop hectares. This indicates that toward the end of World War II many irrigation system in Taiwan were not functioning.

After the War, the repairing of the distorted irrigation systems and the contruction of new ones have been rapidly undertaken by the Taiwan Provincial Water Conservancy Bureau and local hydraulic associations, with financial and technical assistance from the Sino-Amarican Joint Commission on Rural Reconstruction. In the following pages an effort is made to describe briefly the existing irrigation facilities and the improvements made in recent years.

1. Irrigation Facilities

The irrigation facilities in Taiwan fall mainly into two categories - the gravity system and the pumping system. The former is by far more common.

There are over a thousand seperate gravity systems in the island, with varying irrigation capacities ranging from less than 100 hectares to over 100,000 hectares each. With the exception of the six major systems that are supplied from reservoirs, most of the systems are supplied directly from streams. The intakes of such systems fall under three different groups: (1) those without diversion weirs, (2) those with temporary ones, and (3) those with permanent ones.

An intake without a diversion weir is usually located in the convex side of a stream with a stable water course and a rock bank. Such intake is the best of all types. Intakes with temporary diversion weirs or dikes are the most troublesome and expensive. However, irrigation canal intakes of this type are most common in Taiwan. Temporary training dikes or weirs may be built of sand, gravels, rock, or bamboo cages, depending on the material locally available. The temporary diversion weir for the Tsaokung Canal, one of the oldest, was built of mats and sand. The difference of water surfaces above and below the weir is as large as four meters. The bamboo cages with pointed ends are filled with cobbles and laid with the pointed ends toward the down-stream.

These temporary structures are subject to flood damage and are usually washed out several times a year. The instakes with permanent diversion weirs are usually provided with sluices at right angles to the intakes. Some canal intakes have been out of function due to a change in water course.

Pumping systems are usually supplied from streams, drainage channels, or underground sources. Irrrigation pumps vary in size, ranging from a few horse power to 300 horse power. The prime mover is mostly electric power although Diesel engine power is also commonly used. The engines, generators and motors are mostly imported, while the pumps are made locally.

It may be noted that some irrigation systems in Taiwan are a combination of both gravity and pumping systems. The first rice crop may be irrigated from a river elevated by a temporary diversion weir. The second crop will have to depend on pumping because the diversion weir will be washed away and cannot be restored until the water subsides. In some places, one crop depends on gravity irrigation from surface flow, while the other crop will have to be supplied by pumping ground water.

2. Progress Made

The following table is prepared to show the progress made in the irrigation facilities in Taiwan since the end of the War:

	1945	*1956*
Land with irrigation facilities, in ha.	523,208	555,000 (estimated)
Area of rice planted, in crop ha.	499,531	783,629
Rice production in M/T of brown rice	580,894	1,789,828
Rice planted, in crop ha. per ha. of irrigated land	0.955	1.412
Rice yield, in M/T of brown rice per crop hectare	1.163	2.284

The above table reveals a number of important facts. First, it indicated that the work so far has been concentrated more on rehabilitation and improvement of the existing systems than on construction of new ones, as the area of land with irrigation facilities in 1956 was 555,000 ha., compared to 523,208 ha. in 1945. Secondly, the rehabilitation and improvement work has been very successful. Only 0.955 crop hectare of rice was produced from one hectare of irrigated land in 1945, while 1.412 crop hectares of rice was produced from one hectare of irrigated land in 1956. Thirdly, the yield of rice per hectare in 1956 was 2.284 M/T, compared 1.163 M/T in 1945. The increase of the unit yield is not only due to the improvement of irrigation facilities, but also to the use of improved seed, insect control, higher fertilizer use and so forth.

3. Improvements on the Existing Irrigation Systems

As indicated in the above table, the irrigation facilities in Taiwan today are

more efficient than before. This is due to the fact that these facilities were not only rehabilitated but also improved. These improvements included (1) a number of permanent diversion weirs built to replace temporary ones, which used to be repaired several times a year at flooding times; (2) construction of several storage reservoirs; (3) miles of canals with cement lining; and (4) the improvement of old drainage channels and the construction of several new ones.

The plan for the rotational irrigation method, which will be described later in this paper, embodies two important changes in the history of irrigation in Taiwan. First, the quantity of water needed for a certain area is now planned and controlled by installing regulatory and measuring devices. Secondly, a government regulation governing irrigation was recently promulgated.

4. Better Construction Methods Adopted

In recent years better construction methods have been adopted and more complicated structures built. In mixing concrete, aggregates are now measured by weight instead of by volume and water-cement ratio is strictly controlled with a view to safeguarding strength. In earthwork construction, a high degree of compaction of soil is required. In this connection, a new laboratory is now under construction and will soon be completed.

Irrigation structures are now more complicated than they were before. A diversion dam may have an inverted siphon embedded in it. Siphon spillways are also used. For the purpose of removing a bed load, vortex tubes are installed below the intake. Radial gates are sometimes operated by electricity. Structures for irrigation canals have better hydraulic features too.

5. Adoption of Rotational Irrigation

In the past, with very few exceptions, farmers in Taiwan used to apply irrigation water continuously. Except for the time of weeding, fertilization and harvesting, when no water is applied, irrigation continued for about one hundred days. For the purpose of irrigating more land with the same amount of water available, extensive experiments had been made from 1933 to 1943 by the Japanese on the effects of different irrigation methods on crop yields, and of different depths of water on different varieties of rice. Other experiments were designed to ascertain the best intervals between irrigation. Careful analysis of these experimental results made in 1951-1953 by JCRR led to the following three conclusions:

(1) As far as yield is concerned, most tests did not show any appreciable differences between the rotational and the continuous methods, although some tests did show a noticeable increase in yield from the rotational method over the continuous method.

(2) Most tests, however, showed an appreciable decreased water depth for the rotational method as follows:

Depths of water for rotational method	*Corresponding depths of water for continuous method*
0.015 m.	0.030 m.
0.030 m.	0.045 – 0.050 m.
0.036 m.	0.060 m.

(3) Five of the tests indicated a saving of 15.8 per cent to 38.7 per cent of water, or an average of 26.1 per cent for the rotational method. It seems possible that use of the rotational method, together with a better utilization of rainfall and more efficient operation of an irrigation system, could effect a saving of 25 per cent to 50 per cent of water.

The above conclusions have finally received the attention of the government. As a result, one experiment station and four demonstration centers on rotational irrigation were established late in 1954. However, the drought in the spring of 1955 carried rotational irrigation immediately from an experimental stage to an island-wide practice. Of 35 irrigation districts in the island, 33 practised rotational irrigation and out of the total transplanted area of 212,010 hectares, 195,959 hectares or 92.4 per cent practised rotational irrigation. If the rotational method had not been used in 1955, the transplanted area would have been only 139,797 hectares. In other words, an increase of 72,213 hectares or 51.7 per cent was accomplished by rotational irrigation. In addition, another 35,011 hectares were saved by the more rational use of water. The amount of water available during the spring of 1955 was only about 40 per cent of that of normal years.

The 1955 drought was a real test for rotational irrigation. The result has proven beyond doubt that rotational irrigation is a better method and the farmers welcome it. To run rotational irrigation more effectively, however, most of the existing canal systems have to be improved as follows: (a) to control irrigation through installing gates and measuring devices; (b) to reduce percolation loss through lining the canals; (c) to combine small direct turnouts into larger ones; and (d) to enlarge canal capacities. Improvement work along these lines for 3,900 ha. was already completed in 1956, and in 1957 it will be extended to another 17,800 ha.

It is expected that by the end of 1960, 116,000 ha. of land in Thiwan will be provided with irrigation facilities suitable for rotational irrigation.

6. Multipurpose Projects Emphasized

The Chinese proverb says "Irrigation without proper drainage will not be successful". This means that irrigation and drainage should go together. Therefore, for the purpose of attaining maximum benefit from water, a complete basin-wide plan is necessary before any individual project can be considered in a hopeful river basin area. This principle has been strictly followed in all recent hydraulic works. For example, the A-kung-tien Reservoir completed in 1951 is for flood control, irrigation and city water supply; the Tsao Tan Pei Project is for both drainage and irrigation; and the Mukwa project, which is now under construction, is planned for power and irrigation.

The planning phase of a multiple-purpose project – Shihmen Reservoir – was completed in 1955 and the construction work is just underway. After the completion of this reservoir, about 7,395 hectares of dry land will be provided with water and another 46,937 hectares will be made secure with supplementary irrigation. In addition,

benefits from power generation, flood prevention, water supply, etc., are also considerable. Two more basin-wide plans are being considered. One is the Ta-Chia River Basin and the other is the Cho-Shui River Basin. Over 200,000 hectares of land will be affected by these two projects.

7. Ground Water also Tapped for Irrigation Purposes

With abundant rainfall and favourable geological formation, Taiwan has substantial supplies of ground water. The wells dug by the Johston Company in 1950 for the Taiwan Sugar Corporation aroused much local interest in digging wells for irrigation of rice fields. Many surveys have been successfully made, including those on geological formation, existing wells and water levels to determine the ultimate possible supplies of ground water, in order to map out a ground water development program. For instance, the report of the Yunlin ground water survey indicates that at least 250 wells with a possible output of 1,000 g.p.m. each can be developed for irrigation of about 15,000 hectares of rice fields. The ground water surveys in other areas in Taiwan have also given hopeful results.

8. Local Irrigation Organizations Recently Reorganized

After the promulgation of the Public Irrigation System Regulations in 1903 and of the Regulation Governing all Government Built Systems in 1909 by the Japanese, nearly all the irrigation systems in Taiwan were turned over to the local hydraulic associations concerned.

In 1937, by order of the Japanese, 106 hydraulic associations were combined into 38. The number of the associations was raised to 40 after restoration to China in 1945. After much consideration these 40 hydraulic associations were further reduced to 26 in 1956. By comparison, the reorganization gave the new association the following advantages:

(1) By law, the new associations are public entities.

(2) The jurisdictional areas of the various associations are fixed with reference to their natural environment, water resource distribution, use of water for irrigation and other economic factors.

(3) The authority of each irrigation association is vested in the members' representatives' plenary session and these representatives are elected by the members of the association. The chairman of the members' representatives is also the executive head of the association.

SOME RICE STORAGE PROBLEMS AND THEIR SOLUTION IN BURMA

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Prior to the Second World War there was no major problem of paddy or rice storage in Burma. The crop was purchased by paddy brokers, and occasionally by the millers with fixed delivery points. It was milled and moved in such a way that 90 per

cent, or some 3,000,000 tons, was exported between January and June, and the remainder was kept in stock, in small amounts, as paddy, to wait for an enhanced price in the autumn.

Subsequent to 1945, however, a different picture has emerged. Road, rail and port facilities still leave a great deal to be achieved and there is a chronic shortage of seasonal manual labour to handle rice cargoes. A rapid change in world market conditions in 1952 and 1953 found Burma at a distinct disadvantage so far as storage was concerned, and it was to prevent a similar future occurrence, as well as to maintain low internal prices, that a program of storage was embarked upon.

Government's first attempt at the solution of the problem was not a success, but it was forced upon them by sheer necessity. The first attempt was to build 1,600 temporary thatched sheds, each capable of holding a maximum of 300 tons paddy. These temporary buildings are now being demolished. At the same time, loans were advanced to millers to erect storage facilities, and the next step was to build 200 semi-permanent and 270 permanent paddy storage sheds at the Government purchasing locations and adjoining the mills. It was at this stage, 1955, that the author was assigned to Burma. Only a few of the technical problems which were encountered and their solutions are considered within the very limited scope of this article. This particular assignment left little time for scientific research on various points, but by virtue of its magnitude (Government has invested the equivalent of £2 m in storage facilities since 1955) and the urgency involved, had to be pursued often under difficult local conditions.

The first major problem was to design, within the following limitations, a storage unit capable of holding 1,000 tons of grain:

1. 200 such structures required forthwith.
2. Simplicity of erection by semi-skilled labour.
3. Local materials to be used wherever possible.
4. Standardised plan suitable for all Burmese rice growing regions.
5. Adaptability of building for other purposes if necessary.
6. Economic cost per ton storage capacity.
7. Structure to be reasonably permanent: i.e., 40 year life.
8. Storage to be operated initially without mechanisation, but to be capable of adaptation to mechanisation in future.
9. Structure to be as vermin proof as possible under the circumstances.
10. Grain to be stored in separate manageable amounts.

Quite obviously several solutions were possible within these major limitations. The result was a timber structure size 140' x 44' from floor to eaves. The floor was normally 3' above ground level, supported on 14 dwarf brick walls and gave a total static and superimposed load of 0.4 ton per

square feet. Cement lime aggregate concrete was used for foundations; the aggregate was often hauled 100 miles to the site; the bricks were usually locally made; the timber, mostly pyinkado, often had to be transported a long distance. No seasoned timber was available, and it was not possible to undertake stress grading for the structural members. An innovation was the author's design employing full use of the modulus of elasticity, which effected considerable financial savings in the sizes of the timbers used. Galvanised C.I. sheeting was used for the roof, gable ends and end doors. A large metal anti-rat shelf was built into the structure all the way round at floor level. The building was divided into 14 compartments, each 20' × 16', seven compartments on either side of a 12' central passageway; this latter space can also be used for storage. The division walls were all removable and in each compartment a 1" diameter mild steel tie rod was incorporated, 6' above floor level to counteract maximum bending moments in the lateral walls when the building was under load.

The total initial cost was K. 90/– (approx. equal to US $ 20.00) per ton of grain stored.

An interesting problem in this project was that of providing adequate natural ventilation in an effort to overcome the immense build up of solar heat that occurs in metal roofed buildings in the tropics, usually resulting in optimum insect activity conditions.

It is a tradition in the East, and indeed often elsewhere, to employ a louvred ridge ventilator, but, except when the air flow is parallel to the ridge, there is direct wind pressure against the louvres on one side, thus hindering the exit of air. It was therefore necessary to provide a form of natural ventilation based on a combination of low wind velocity (the annual average for Rangoon over the period 1880-1940 is less than 4 m.p.h.) and the influence of gravity to set up an aspirating effect in a group of ventilators.

Having determined the materials from which the building was to be constructed it was possible to ascertain their respective U values and the resultant amount of heat from solar radiation measured in B.Th.U's, to be dealt with in ventilation. It was decided to work on the basis of a 10°F temperature rise within the building from floor to roof and given five changes (minimum) of air per hour, five outlet ventilators each of 930 sq. inches area were required.

The inlet ventilation was designed to twice the outlet area, and a continuous inlet ventilator of 12" depth below the eaves, assuming 25 per cent deduction of free air space due to framing posts and bird netting was sufficient for this purpose.

Hand in hand with the construction of "improved type" storage sheds came the next step, and problem, in the construction program, namely that of providing a number of buildings complete with storage silos. Here again the limiting factors were essentially the same, except that some imported materials could be used.

The resultant solution is slightly different and is briefly described as a building size 80' × 40' × 16' to eaves, having a steel framework and clad with asbestos cement sheeting. There are ten vertical inlet (wall) ventilators and ten outlet (ridge) ventilators. The building and silos were obtained under a Barter Agreement with Poland and the first of the 200 units were received in Rangoon within six months of the Agreement being concluded. Two interesting technical problems arose in connection with this portion of the program. The first was to provide a dry concrete floor onto which paddy in bulk or rice or bran in bags could be stored directly. This was achieved by the provision of a concrete - bituminous sandwich whereby the lower 3" layer of reinforced concrete in contact with the ground was separated from the upper 3" layer of concrete by a bituminous membrane, acting as a horizontal water proof barrier. No. 9 B.R.C. reinforcement was placed in the lower layer to support the concrete slab in tension.

The second problem was to provide a cheap demountable silo and was solved by the use of sheets of small industrial steel mesh lined with proofed hessian. It is a well known fact that the use of circular silos within a building reduces the capacity based on total floor area by some 25 per cent, but as is so often overlooked in agricultural fixed equipment, the loss of 25 per cent storage space is more than compensated by a building arrangement easily adaptable to other purposes; and the pattern of agriculture is not static. Again, a rectangular bin involves, structurally, both compression and tension in a lateral direction under load, whilst a circular bin involves mainly tension together with a varying amount of vertical pressure in the walls due to friction. Thus, in a circular bin 15 ft. deep and 15 ft. diameter, filled with paddy at say 14 per cent moisture content, the total lateral pressure in the lowest 12" will be approximately 3,180 lbs. and for this purpose it is possible to use a small industrial welded steel mesh such as No. 8 gauge steel rods at 2" × 2" square spacing, to give a safe tensile strength of 3,240 lbs. per foot width. The steel mesh was supplied in widths of 5' 6" and the bin built up in three layers with a 6" overlap at the two junction bands. It was erected as grain filling proceeded by four completely unskilled operators and on completion holds 2,250 baskets (46 lbs.) of paddy. This in itself solves an important problem, namely, that of maintaining an accurate check on paddy stocks. Such a silo costs initially approximately K. 13/- or US$2.75 per ton stored, and is suitable for radial-flow forced-air grain drying, a system which does away with expensive adaptations in floor works.

The foregoing notes represent but a fraction of the problems encountered in a program of this magnitude, and tend to emphasize the engineering aspect. Other problems dealt with included such aspects as mechanical handling, pest control, management, grain drying and moisture measurement.

BETTER FARM PLANNING FOR BETTER MANAGEMENT AND FAMILY LIVING

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The average size of rice farm in Asia and the Far East is all too small. In East Pakistan, it is slightly less than 4 acres.

Farming in the region is both a business and a way of life: a business, because the cultivators have to make earnings from their limited resources; and a way of life, because they live on the farm and have to get as much satisfaction out of it as possible. In other words, in the betterment of rural life, due considerations should be given to both farm work and family enjoyment.

Judged by the above definition, farming in the region is neither a good business nor provides a comfortable living. This is particularly true of tropical monsoon areas such as East Pakistan, where rice farming is often a matter of gambling with nature. When the crop fails, there is not enough rice for the family to eat; but when there is a bumper crop, the price drops. The cultivator is affected in both ways. Therefore, it is all the more important that a good farm plan should be worked out ahead of time, in order to avoid much of the adversity and to bring about a maximum amount of farm income.

Scope and Purposes of Farm Planning

Cultivators are generally aware of the fact that successful farming requires sound organization and good management. Organization here means the preparation of a workable production plan, whereby land, labour and capital can be efficiently utilized. Management refers to the implemention of the plan. The whole process is commonly known as farm management. Therefore, better farm management begins with better farm planning.

Farm planning takes into consideration many factors, such as the problem of farm operation, the selection of an enterprise, or a combination of several enterprises, the size of the operation, the neighbouring farms and the outlook of general price movements. These factors will now be briefly explained. However, it has to be pointed out that the majority of cultivators in the region are born rather than made. That is, they are used to following traditional farming practices but not to the need for decision in making the approach. To introduce the idea of farm planning, one has to induce the cultivators to accept the desirables changes needed in their farms.

As regards the operation of a farm, cultivators are primarily concerned with increased production of a certain crop or of livestock. This can be achieved either by increasing the maximum output with fixed input, or by obtaining a given output with various means of input.

Take the use of fertilizers as an illustration. First, the cultivator would want to

know how much fertilizer should be used to obtain the maximum yield. After knowing the input-output relationship, the cultivator would have to figure out whether the returns of additional output would be justified for the cost of additional input. His first decision would be based on the cost-returns relationship of that specific enterprise. But the use of fertilizers may include ammonium sulphate, farm yard manure, night soil, bonemeal, green manure and others. Due to unavailability of some of these fertilizers, the cultivator might have to substitute one with the other, or to use two or three kinds of indigenous manures to replace the required amount of commercial fertilizers which would give the maximum yield. All these substitutions must be based on their cost-returns relationships. Indeed, it would be of a great help if such information could be made available to the cultivators !

To reduce risks and uncertainty, small farms in the region are mostly diversified by combining several enterprises under one management. The problem is that it is not always easy to make a correct combination of serveral enterprises. One has to know how these enterprises are interrelated, and to decide whether they are competitive or supplementary. Then a good crop rotation system could be worked out to include the raising of livestock, which would help to maintain land productivity and to achieve a better labour distribution. It is, therefore, important that the small cultivators with limited resources should think through what enterprises should be combined in order to yield the highest economic returns and to give the family a maximum satisfaction.

No two farms are exactly alike in their resources. Some farms may have surplus labour, while others may have surplus land. For this reason, farm planning has to be based on the actual conditions of the farm concerned. A farm may have surplus labour but insufficient land. It would be advisable for that farm to rent some land or to introduce some subsidiary work, in order to utilize the available labour more efficiently. At this juncture, the cultivator should know, within his resources, what would be the optimum scale of his farm operation. Since the family labour is fixed, it would be easy for the cultivator to expand his scale of operation even to the extent of hiring some additional labour. Before making a farm plan, the cultivator has to appraise carefully his available resources to serve as a basis for deciding on the operation of an enterprise, a combination of enterprises and the scale of farm operation.

The best farm plan is the one which is based on local conditions. The cultivator must be familiar with his neighbourhood. He should find out why some of his neighbours are successful and others are not, under similar conditions. By making such comparisons, he begins to understand where he stands. A wise cultivator will quickly follow the example of a successful neighbour.

All cultivators are keen about price movements. Any fluctuation in price will have direct effects on the cost-returns relationship. Prices are sometimes unpredictable. So the farm plan should be adjusted during the stage of implementation if the fluctuation is serious enough.

A Chinese proverb says, "Although the size of a sparrow is small, yet he is physiologically as perfect as a big bird". This

principle can be applied to the management of small farms in the area. Small farm may have different problems, but the principle of efficient use of available resources to obtion maximum economic returns and family satisfaction remain the same in both cases. There is no other way to raise the standard of living of the farm people, unless the farm is under a good management. Many development schemes for the increase of agricultural production, such as seed multiplication, fertilizer extension, better implements, pest and disease control, irrigation and drainage, fail to bring about maximum benefits, simply because there are no ready-made plans of individual farms, which could implement these schemes effectively at the farm level.

Farm Management Studies and Planning

Farm management studies in general include both intra-farm and inter-farm aspects. The intra-farm studies are concerned with input-output relationships; the best combination of farm enterprises; the utilization, substitution and conservation of farm resources; the requirements and distribution of labour and capital; the use of by-products; price received; and price paid; and other factors related to the problems of organization and operation on a farm. The inter-farm studies are concerned with problems of competition, agricultural marketing and credit, and relationships among farms as well as between farm and non-farm business. As far as farm planning is concerned, the emphasis is largely on intra-farm studies.

To make intra-farm studies requires keeping simplified farm accounts or farm records, and taking farm management business surveys to collect the needed information over a period of time. It is true that most of the cultivators in the region are illiterate and cannot very well keep accounts or records. However, in most places there are a few cultivators who can read and write, if time can be taken to find them. They should be induced and taught to undertake the task of keeping a record. Although these selected cultivators may not be representative in their areas, their records will give the actual picture of receipts and expenditures of their farms. If this method is not practicable, the alternative is to take a farm management business survey by the random sampling method with a well prepared survey schedule, either in a tabular form or in a questionnaire form. The survey schedule should cover one full year of business operation, from which the income position as well as factors of success or failure can be made clear for both farm and home management. This latter method is less expensive and can cover a wider area. It can give a better result if the survey can be repeated on the same farms over a period of years.

Farm planning is based on the past experience to reallocate the available resources for more efficient uses, to introduce desirable changes in crop or livestock system, and to budget the receipts and expenditures for maximum profits. It is a forward looking approach. From a well-budgeted farm plan, one can foresee the resource requirements, development potentialities, income prospect, and repayment capacity of that farm if the plan is properly implemented.

Examples of Farm Management Studies in Pakistan

Upon the request of the Government of Pakistan, Dr. W.Y. Yang, FAO Farm Management Specialist in Rome, spent three months in 1952 in West Pakistan. During the period he carried out a trial farm management survey in Sakrand, Sind, and the result was very convincing (1). In his report, he made some definite recommendations on farm management studies to the Government for consideration and adoption (2). After his departure, Mr. Guy Miller, Point IV farm management adviser from the U.S.A., continued the studies in West Pakistan until 1957 when he left the country.

Since I953, the author has been serving as ETAP/FAO adviser to the Government of East Pakistan on farm management studies in connection with the development of the Ganges-Kobadak Irrigation Development Scheme. He began his work with a detailed farm management survey of 150 farms in the first unit of the Ganges-Kobadak Project area in 1953 (3). Based on the findings of this survey, he proposed some changes in the farming system after the completion of the irrigation scheme (4). An example of the proposal for a five acre farm can be given below.

This farm family has six people, including the farmer himself, his wife, one of his old living parents, his adult son, and two minor children. The man labour is supplied by the operator and his adult son, with some hired help during the busy season. The homework and a part of farm chores are done by his wife and old living parent. He owns all his land and has thatched houses, just large enough to shelter his family and the livestock, including a pair of bullocks, one cow, one calf, two goats and five chickens. He has enough farm implements.

Table I gives comparison of the cropping system and land use of this farm between the present practice and a proposal after irrigation facilities are made available. Some of the salient features of this comparison can be stated as follows:

(a) The land used for farmstead, roads, etc. is 0.35 acre at present, but after irrigation facilities are installed, it will be 0.40 acre for better roads, irrigation channels and bunds.

(b) For the first year, the acreage of *aus* is slightly reduced, and the land planted to *aman* is also cut to 0.80 acre. Since irrigation makes double cropping possible, one acre of *aman* is added as a second crop of the year after *aus*. A better practice, as proposed by the local agronomist, is to transplant *aman* after *aus* is broadcasted. Actually the total acreage of paddy is increased from 3.39 to 4.10 crop acres.

(c) The acreage of jute is now under the Government contol. It is anticipated that the Government will not encourage any significant increase in the jute acreage in the near futute. For this reason, there is no change in acreage necessary after irrigation.

(d) More land will be used to grow sugar cane after irrigation, partly due to the need of cash income for the cultivator. An increase from 0.12 acre to 0.40 acre is suggested.

Table 1. *Cropping Pattern for A 5-Acre Farm*

Land Use	Before Irrigation		After Irrigation	
	Acres	Per Cent	Acres	Per Cent
Farmstead, road, etc.	0.35	7.0	0.40	8.0
Perennial crops:				
Orchards	0.20	4.0	0.30	6.0
Sugar cane[1]	0.12	2.3	0.40	8.0
	0.32	6.3	0.70	14.0
First crops:				
Aus paddy (Autumn paddy)	2.33	46.7	2.30	46.0
Aman paddy (Winter paddy)	1.60	32.0	0.80	16.0
Jute	0.40	8.0	0.40	8.0
Green manure	—	—	0.40	8.0
	4.33	86.7	3.90	78.0
Second crops:				
Pulses	1.25	25.0	1.00	20.0
Oilseeds	0.20	4.0	0.50	10.0
Cereals	0.20	4.0	0.40	8.0
Spices	0.02	0.4	0.05	1.0
Tobacco	0.01	0.2	0.05	1.0
Aman paddy (Winter paddy)	—	—	1.00	20.0
Potatoes	—	—	0.20	4.0
Fodder crops	—	—	0.50	10.0
	1.68	33.6	3.70	74.0
Third crop:				
Green manure	—	—	0.5-1.0	10-20

1 *The growing period of sugar cane in East Pakistan is one year.*

(e) An increase in the acreage for orchards is recommended after irrigation. It is suggested that the orchard garden be properly managed to grow more fruits and vegetables, to increase production and to improve nutrition.

(f) As the acreage for double cropping is increased, it will be necessary to provide land for green manure crops in order to help maintain soil fertility. Hence, an 8 per cent of the land is allotted for this purpose among the first crops of the year. Later in the year another crop of green manure can also be grown.

(g) Among the second crops of the year, the acreage of pulses is reduced by about one-quarter of an acre, but the acreage for groundnuts and soybeans is increased to help to solve the problem of oil shortage in this area.

(h) The acreage for spices, tobacco and potatoes is to be increased for home consumption as well as for cash income.

The advantages of these changes in land use and cropping system, as suggested above, may be summarized as follows:

(a) The new cropping system is expected to produce enough food for home consumption as well as enough feeds and fodders for livestock to use.

(b) There are more sources of cash income from such crops as sugarcane, oilseeds, potatoes, and other winter crops.

(c) For the second crops of the year, more than one-third of the area will be planted to leguminous crops.

(d) This new cropping system permits an even distribution of farm labour, both man and animal through-out the year.

The economic returns from the crops grown on this farm without irrigation facilities in 1954-55 is shown in Table 2. In addition there was an income of Rs. 130 from livestock raised and livestock products produced on the farm. This brings the sum total of receipts to Rs. 697.2 from both crops and livestock for the farm in the year.

After irrigation facilities are installed, the yield of rice, oilseeds, spices, tobacco, and the orchard garden can be expected to increase at least by 20 per cent; that of pulses, cereals, and potatoes by 25 per cent; and sugar cane by 50 per cent. The crop receipts obtainable then can be shown in Table 3, based on the same price level in 1954-55.

Table 2. *Receipts from Crops in 1954-55 without Irrigation*

Land Use	Crop acres	Production in Maunds[1]	Price per Maund in Rupees	Total Receipts in Rupees
Farmstead, etc.	0.35	–	–	–
Aus (clean rice)	2.33	20.97	9	188.7
Aman (clean rice)	1.60	14.40	10	144.0
Jute (fibre)	0.40	5.20	8	41.6
Sugar cane (gur)	0.12	4.20	10	42.0
Orchard garden	0.20	–	–	80.0
Pulses	1.25	6.75	7	47.3
Oilseeds	0.20	0.90	12	10.8
Cereals	0.20	1.00	7	7.0
Spices	0.02	0.13	20	2.6
Tobacco	0.01	0.08	40	3.2
Total	6.68	–	–	567.2

1 One maund is approximately 82 pounds.

Table 3. *Possible Receipts from Crops with Irrigation*

Crops	Crop acres	Production in Maunds	Price per Maund in Rupees	Total Receipts in Rupees
Aus (clean rice)	2.30	24.8	9	233.2
Aman (clean rice)	1.80	19.4	10	194.0
Jute (Fibre)	0.40	5.7	8	45.6
Sugar cane (gur)	0.40	21.0	10	210.0
Pulses	1.00	5.8	7	40.6
Oilseeds	0.50	2.7	12	32.4
Cereals	0.40	2.5	7	17.5
Tobacco	0.05	0.5	40	20.0
Spices	0.05	0.4	20	8.0
Potatoes	0.20	24.0	3	72.0
Orchard garden	0.20	–	–	96.0
Fodder crops	0.50	80.0	–	–
Green manure	1.00	–	–	–
Total	8.80	–	–	969.3

After irrigation facilities are installed, the gross income from crops grown on the farm would increase by more than one-third, as indicated in Tables 2 and 3. In addition, there would be an income of Rs. 200 from the livestock, bringing the total sum of incomes from both crops and livestock to Rs. 1,159.3.

As to the minimum requirements of the farm for both periods – before and after irrigation facilities are made available – estimates have been made and are shown in Table 4 for comparison.

Table 4. *Minimum Requirements of the Farm Before and After Irrigation Facilities being Installed*

Particulars	Before Irrigation		After Irrigation	
	Quantity (Maunds)	Value (Rs.)	Quantity (Maunds)	Value (Rs.)
Food expenses:				
Rice (food, seeds, wastage inclusive)	32.0	288.0	35.2	316.8
Pulses	2.4	16.8	2.7	18.9
Oilseeds	3.6	43.2	3.9	47.1
Dairy and poultry products	–	30.0	–	33.0
Farm expenses:				
Livestock purchases and tool replacement	–	30.0	–	60.0
Land tax and other levies	–	33.0	–	33.0
Water charges	–	–	–	40.0
Better levy of irrigation	–	–	–	10.0
Hired labour	–	20.0	–	20.0
Livestock expenses:				
Straw and rice bran	Self-sufficient		Self-sufficient	
Oilcakes, salt, pulses	–	50.0	–	40.0
Total	–	511.0	–	618.8

From Tables 2, 3 and 4 and related discussions, it can be seen that the difference in the amounts of income from the farm between the present practice without irrigation and the future practice with irrigation is great. The present practice can only bring an income of Rs. 186.2 (Rs. 697.2–Rs. 511.0), while the future practice will increase the income to Rs. 540.5 (Rs. 1,169.3–Rs. 618.8), a difference of Rs. 354.3. With this increased amount of income the farmer can do a great deal to improve his farm and family living.

As a demonstration, the Ganges-Kobadak Irrigation Development Scheme has been conducting a pilot irrigation scheme on a block of 550 acres in Baradi, Kushtia, since January 1956. At first, only a few cultivators were willing to cooperate in the matter of reorganizing their resources. In 1957, more cultivators joined the movement and adopted the new cropping system. Although there are still problems of implementation, the progress made so far seems very encouraging.

A Brief Review of Farm Management Studies in the Region

Farm management studies are a comparatively new field of learning in most Asian countries. The following is a brief review of some of the developments in several countries in the region according to the information available (5).

In the Philippines, farm surveys and marketing studies have been undertaken on a large scale in recent years by the Agricultural College of the University of the Philippines. In Thailand, a farm economy survey, including over 6,000 farm households, was completed in 1953 by the Division of Agricultural Economics of the Ministry of Agriculture; and there were pilot study projects being carried out at the village level to determine the effects of technical and economic developments on family life and rural living. In Korea, a survey of 30 rice farm households was conducted in 1956 by the Central Agricultural Technical Institute to ascertain the utilization and seasonal distribution of farm labour and the relative advantages of mechanical power, draft-animal and manpower.

Farm cost studies were started in India and Pakistan in the early '20's. Since 1954, the Government of India has been conducting a systematic and comprehensive research program for determining the relative merits of cost accounting methods and survey methods under local conditions; and for improving research methods, such as sampling techniques, questionnaire forms, and methods of analysis. This study has been in operation in six states for a period of three years. In each state 20 villages were selected for the study of the accounting method, and 20 villages for the survey method. Altogether, 2,400 farms have been covered by the survey method and 1,200 by the accounting method.

In Malaya, agricultural economic surveys have been carried out to serve as a basis for the formulation of a program of farm management studies. In Burma, considerable progress has been made in the testing of farm implements and tools and in the methods of using them under local conditions. In Indonesia and Ceylon, studies on plantation management have been in progress for more than 20 years.

In Japan, the development of farm bookkeeping and cost accounting has been remarkable since the '20's under the auspices of government agencies and educational institutions. The original purpose of the study was to provide data for the determination of production costs and price policies, and for the understanding of general agricultural conditions. However, this study proved very effective in helping farmers to improve their management practices and thus to increase labour efficiency and their earnings. At present the bookkeeping scheme is under the Statistics and Survey Division of the Ministry of Agriculture and Forestry. The scheme includes three types of studies: (a) farmer's economy; (b) farm management, and (c) cost of production (6).

For the first type of study, the entire country was divided into 11 agricultural regions and 132 sub-regions and a total of 5,800 farm households (one household selected for every 1,000 households in the area) was included in the study for 1954. In each of these households selected farm records and books were kept throughout the year by the farmers themselves with some guidance from the government officials.

By farm management studies, eight types of farming systems have been identified in the country: (1) low land farming, (2) up-land farming, (3) mulberry and silkworm raising, (4) livestock keeping, (5) fruit growing, (6) vegetable gardening, (7) tea growing, and (8) mixed farming. From each type of the farming system, 3 to 92 farm households (total 219) in 1954 were selected to keep double entry books.

As regards the study on production cost, data was collected for about 60 farm products. Records were kept by the farmers who recorded all farm expenses incurred from the preparation of land up to the marketing of the crop. For such major farm products as rice, wheat, barley, naked barley and silkworm cocoons, the stratified random sampling method was adopted, and for other farm products the purposive sampling method was used.

The immediate purpose of all these types of surveys is to provide data for the publication of comprehensive statistical reports by the Ministry for general use. As to the improvement of farming efficiency, it is an assignment to the farm management research workers in the Central Research Institute and to the farm management specialists who are engaged by the prefectural governments to conduct farm management studies, and to assist in improving farm organization and operation at the farm level.

In addition to these large-scale farm bookkeeping schemes, the Gevernment of Japan also has conducted other farm management studies, such as the establishment of farm management experiments and model farms to determine management practices that are adaptable to the various regions. In 1956 there ware 127 farm management experiment farms in the country. Recently econometrical studies of farm management problems and the application of linear programming, or activity analysis, to farm management problems have also been started and aroused much interest among the research workers.

Japan so far is the most advanced country in the region by applying the farm management research results to the farming population through the extension service, which is also highly developed. In 1956 there were about 11,000 farm advisers, 1,500 home advisers and 665 subject-matter specialists in the whole extension service in Japan. Of these subject-matter specialists, 63 were farm management specialists.

FAO and Farm Management Studies in the Region

At its fourth session of the International Rice Commission held in Tokyo, Japan, in October 1954, it was recommended that Member Governments should give careful attention to the desirability of taking immediate action " to provide necessary facilities in respective sample areas for determining labour and power requirements, distribution of labour, the need of certain farm operations and the cost of operating different types of equipment and power in the production of rice". To implement this recommendation, FAO sent a staff member to member countries in the region to initiate the desired studies in the field of farm management. With a grant from the Council on Economic and Cultural Affairs, Incorporated, New York, a farm management consultant was engaged by FAO to provide assistance to Member Governments in the region in undertaking the farm management studies (8).

The first Farm Management Development Center was held in Tokyo, Japan, from 15 October to 10 November 1956. Twenty-two participants from eight member countries attended the Center. The objective of the Center was to develop principles and methods for making farm management studies on problems of farm power, labour and machinery, especially in connection with rice cultivation, as a basis for improving farming efficiency (5).

The second Farm Management Development Center was held in New Delhi, India, between 15 October and 9 November in 1957. 35 participants from 10 member countries attended it. The objective of the second Center was to develop techniques in farm planning and budgeting for adaptation to conditions obtaining in the region to improve farm production, increase farm income and raise the standard of living.

Further Development Centers on Farm Management are planned for the region in the coming years in order to promote farm management studies. However, it is expected that Member Governments will follow this up with national training programs to train more people to carry out the work.

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SUMMARY OF RECOMMENDATIONS OF THE JOINT MEETING OF THE THREE WORKING GROUPS OF THE INTERNATIONAL RICE COMMISSION HELD IN VERCELLI, ITALY IN SEPTEMBER 1957

The Seventh Meeting of the Working Party on Rice Breeding, the Sixth Meeting of the Working Party on Fertilizers and the First Meeting of the *Ad Hoc* Working Group on Soil-Water-Plant Relationships of the International Rice Commission were convened jointly in Vercelli, Italy, from 23 to 28 September 1957 by the Director-General of FAO and through the kindness of the Government of Italy and attended by a total of 47 participants representing 17 Member Countries, 4 Non-Member Countries and 1 international organization. The following is a summary of recommendations, in addition to the numerous suggestions included in the body of the report:

A. The Working Party on Rice Breeding recommended that:

1. The FAO *indica x japonica* hybridization project be followed up by the extensive use of "intermediates" in crosses with *indicas*, and that in order to accomplish this FAO be asked to collect seed of from 50 to 100 "intermediates" to distribute to interested countries, this seed being obtained from North, Central and South American sources as well as from the participating countries.
2. The Third Training Centre on Rice Breeding be held, if possible,

in 1959 in Japan and that a larger proportion of emphasis than in the previous training centres be devoted to seed production and distribution.

3. In view of the desire of countries not yet having a well developed seed improvement scheme to have as much help as possible in the development of such schemes, FAO take steps to furnish these countries with an outline of the essential features of several of the most satisfactory schemes now in operation.

4. The report of the small group formed at the Sixth Meeting of the Working Party on Rice Breeding in 1955 "to examine the present position of linkage studies in rice, resolve difficulties of nomenclature and prepare a report to be considered at the next meeting of the Working Party" be completed and circulated to member countries as soon as possible and that this item be placed on the agenda of the next meeting.

B. The Working Party on Fertilizers recommended that:

5. These countries which have not yet presented summaries of NPK fertilizer trials conducted during the last ten years, could present this information at the next meeting of the Working Party on Fertilizers. These may be reported in the manner as suggested in the fourth recommendation of the Fifth Meeting of the Working Party.

6. As there is still considerable difference of opinion on the efficacy of different plant nutrient carriers and on the best time and method of fertilizer application, all available information on these subjects may be thoroughly reviewed and discussed at its next meeting.

7. As not much work has yet been reported on the effects or deficiencies of trace elements, the countries which have already conducted work in this field, report their findings (even though no response has been observed) at the next meeting and that work be initiated in countries where no such investigations are under way.

8. Because in a number of countries the cultivators can purchase only a limited quantity of fertilizers and hence it is necessary that the funds available be put to optimum use, interested Governments may undertake appropriate experiments to elucidate whether the limited amount of fertilizer should be used in the field or in the nursery, or partly in both, for the best economical returns.

9. As very little work in the field of soil and plant analysis has been reported to the Meeting, and being conscious that the work in this very important field should progress, if practices for raising soil fertility and increasing per hectare yields are to be developed on a sound basis, countries conducting formal field fertilizer trials, either

complex tests or simple tests on cultivators fields or both, should make an effort to examime soil samples at least representative of the surfacesoil (15 cm.) from as many test sites as possible by analytical methods outlined in the body of the report, and that countries should also undertake foliar and plant analysis and soil research work which would help to elucidate some of the many unsolved problems concerning nutrients and toxic conditions in rice soils.

10. Although considerable useful information on the use of fertilizers is at hand, specific knowledge for local conditions is not yet precise enough, hence comprehensive experiments be conducted in the main soil regions of the different countries under various soil-water regimes. In carrying out the experimentation, due regard needs to be paid to the use of promising varieties of paddy. Some of the factors that could be tested in such experiments are listed in the body of the report and each country could decide the ones that are particularly valuable under their conditions.

11. The Regional Soil Fertility Specialist for Asia and the Far East should contact Governments for the implementation of the above program which should also include the subsequent recommendations of the joint meeting of the Working Parties as regards the carrying out of simple fertility tests on cultivators' fields and the intensification of research work on the physiological diseases of the rice plant.

C. The Joint Meeting of the Working Parties on Rice Breeding and on Fertilizers and of the *Ad hoc* Working Group on Soil-Water-Plant Relationships recommended that:

12. In view of the desire of Member Governments to continue the study of variety-fertilizer interaction and considering that this interaction is affected by several other factors such as levels of fertilizers, time and method of application, spacing between plants, age at transplanting, irrigation management, etc. member countries undertake comprehensive experiments to test simultaneously the effects of these factors and compile and present the results of the experiments at the next meeting, and that a summary table describing the scope and nature of various investigations, similar to the illustration given on page 50 of the draft report be also supplied in order to facilitate the collation of the results on a regional basis.

13. Considering the desirability of utilizing modern experimental techniques such as confounded designs, fractional replications, etc. in the variety-fertilizer experiments, FAO prepare and distri-

bute to Member Governments details of suitable experimental designs.

14. Considering that the preliminary results of the Cooperative Variety Trials have shown promise in some of the countries, this project be continued according to the scheme presented by the FAO Regional Rice Consultant at the Sixth Meeting of the Working Party on Rice Breeding.

15. Governments give their increased support for extending the work of simple fertilizer tests along the lines suggested by the Working Party on Fertilizers, since its first meeting in 1951. The importance of this work to Member Governments is given in the body of the report.

16. The project on physiological diseases in paddy be continued on a cooperative basis and that Jisuke Takahashi of Japan take over a the coordinator of the project.

17. In view of the importance to member countries of the proposals for reorganization of the work of the International Rice Commission FAO circulate these proposals well in advance of the next session of the Commission in order to give the member countries adequate time to study them and to enable the countries to brief their delegations adequately. The opinion of the Meeting on the establishment of Sub-commissions on Rice Improvement and on Rice Soils and Rice Fertilizer Practices is expressed in the body of the report.

		Price in U.S.$
No. 18	Cadastral Surveys and Records of Rights in Land, by Sir Bernard O. Binns, 1953. 67 p.	0.50
19	Zebu Cattle of India and Pakistan, by N.R. Joshi and Ralph W. Phillips, 1953. 256 p.	3.00
20	Soil Surveys for Land Development, by C.G. Stephens (Ed.), 1953. 110 p.	1.00
21	Legumes in Agriculture, by R.O. Whyte, G. Nilsson Leissner and H.C. Trumble, 1953. 367 p.	3.00
22	Agricultural Development and Rural Reform in Denmark, by F. Skrubbeltrang, 1953. 320 p.	3.00
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24	Joint FAO/WHO Expert Committee on Brucellosis, Second Report, 1953. 36 p.	0.25
25	Advances in the Control of Zoonoses, Bovine Tuberculosis, Leptospirosis, Q Fever, Rabies, 1953. 275 p.	3.00
26	Inter-Relationship between Agrarian Reform and Agricultural Development, by Erich H. Jacoby, 1953. 65 p.	0.75
27	Essentials of Rural Welfare, by the Rural Welfare Branch, 1949, 1953. 43 p.	0.50
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29	Training Rural Leaders, 1949. 135 p.	1.50
30	First Report of the Joint FAO/WHO Expert Committee on Meat Hygiene, 1955. 52 p.	0.60
31	Public Lands, by Andrew W. Ashby, 1956. 47 p.	
32	Vibrio Fetus Infection of Cattle, by J.A. Laing, 1956. 51 p.	

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